

POL Glider First Sea Trial (November 2009)

**Phil Knight
Chris Balfour
John Kenny &
Danny McLaughlin**

November 2009

POL Glider First Sea Trial (November 2009)

Firth of Lorn (Scotland)

Glider: Zephyr-117

Phil Knight, Chris Balfour, John Kenny & Danny McLaughlin

Overview

The first sea trial was arranged to test the glider and associated facilities. This was carried out at the Scottish Association for Marine Science (SAMS), Oban, Scotland.

Preparation (2-6 Nov)

The Slocum Glider (Zephyr-117) was ballasted for values of salinity ranging from 29-35 PSU. The weight distribution for each salinity value between 29 and 35 PSU in one PSU intervals was noted. This was carried out to allow for field adjustments of the Glider to reflect local salinity conditions which had in the past varied between 29 and 35 PSU. The Glider was eventually set up for 33 PSU.

In parallel, experiments were carried out on SSH tunnelling into the Dock Server from outside the firewall; a requirement for control of the Glider in the field without access to Freewave communications (See Appendix 1).

Sea Trial (10-11 Nov)

The first sea trials of the Glider were carried out in the Firth of Lorn (See figure 1) near to the Scottish Association for Marine Science (SAMS) Laboratory, Dunstaffnage. The RV Seol Mara was originally chartered for the trials, however due to refit problems the RV Calanus was offered as a replacement.



Figure 1. Location of Glider trial (Firth of Lorn)



Fig.2 Glider on RV Calanus



Fig.3 Glider testing with rope attached



Fig.4 Deployment of Glider



Fig.5 First release without rope/buoy

Summary of progress

A series of tests were carried out as suggested in the Glider manufacturer's manual. See figures 2-5 for photographs of deployment and recovery in the Firth of Lorn.

On bench (back deck) pre-mission testing

- Power on glider and enter glider dos by typing *ctrl-c*
- Type *put c_air_pump 0* (stops air pump from running)
- Type *callback 30* (hang up Iridium phone for 30 minutes)
- Test GPS by typing *put c_gps_on 3*, finish by *put c_gps_on 1*
- Test motors by typing *lab_mode on* and then *wiggle on* (run for 3-5 minutes)
- Finished *wiggle off*, *lab_mode off*
- *run status.mi* (to confirm that all sensors are being read)

In water testing

Once the *status.mi* mission had completed normally the glider was deployed. During these first missions the Glider was attached to a 20m length of rope with a small surface float.

The first mission to run was *ini0.mi*. This mission was set to 1 yos (one up and down), dive to 3m, fixed pitch and fin. This completed successfully.

This was followed by the following missions:

ini1.mi (Does 3 yos, dive to 5m, climb to 3m, heading North, pitch at ± 20 degrees)

ini2.mi (Goes to a waypoint 100m south of dive point, does yos, dive to 5m, climb to 3m)

ini3.mi (Goes to a waypoint 100m north of dive point, does yos, dive to 5m, climb to 3m)

Data were stored internally and a subset sent via FreeWave (short range radio) and Iridium (Satellite communications). The data was received via the Dock Server machine on the ship via FreeWave, and on the Dock Server installed behind the firewall at POL via the Iridium/RUDICS (via satellite and direct internet access across the POL firewall). See Appendix 1 for details on how to set up the SSH tunnels to access the Dock Server from outside the POL firewall.

Results from Mission *ini2.mi* (with rope/buoy)

The results of depth against time are in figure 6, as plotted using the Matlab routine Glider View.

- Mission: *ini2.mi* (**with** rope/buoy)
- File: unit_117-2009-314-4-0-dbd(01040000)

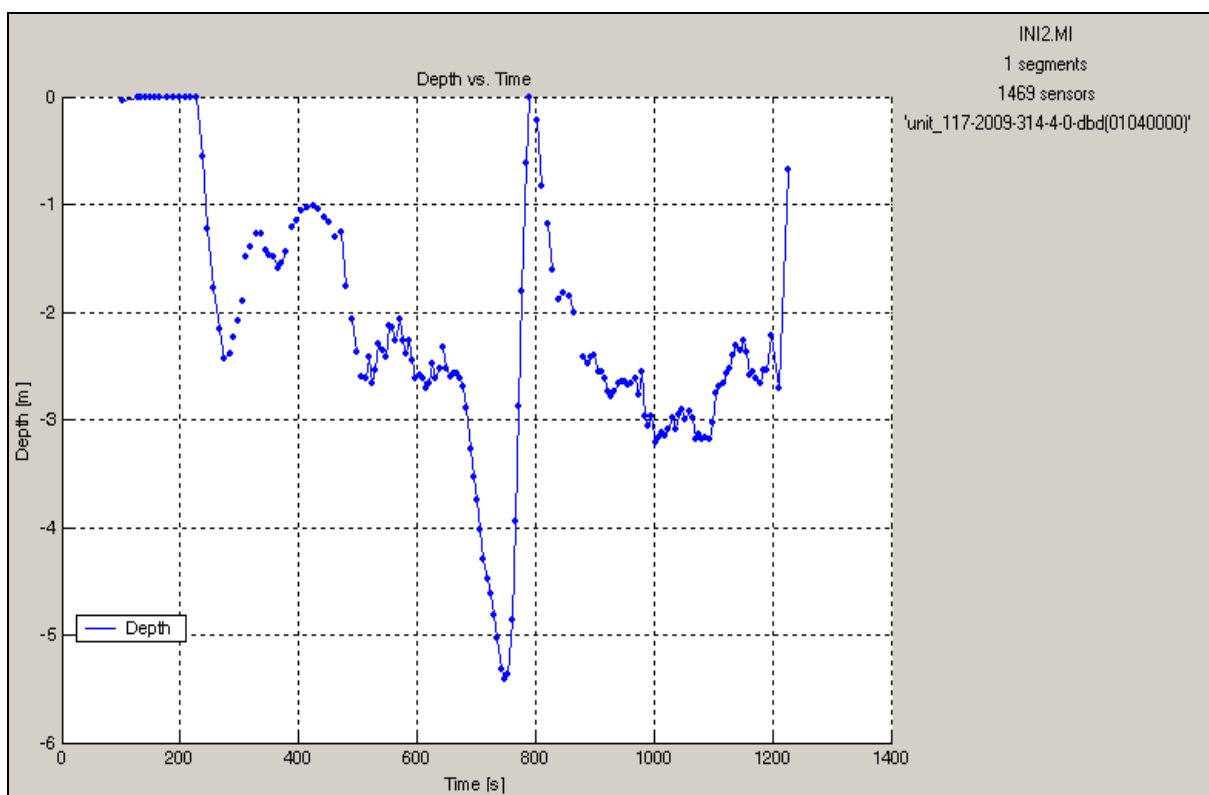


Fig 6. Depth data (*ini2.mi* mission, WITH rope/buoy)

The results show that the Glider struggled to dive to 5m and to complete yos up to 3m. This was likely caused by the extra drag of the rope and buoy. However, as a recommended test it was carried out to verify that the Glider would return to the surface after diving.

Results from Mission *ini2.mi*

The following plots are from the Matlab routine (Glider View). Refer to Appendix2 for all the plots from this mission.

- Mission: *ini2.mi* (**no** rope/buoy)
- File: unit_117-2009-314-8-0-dbd(01080000)

The Glider made seven yos diving down to 6.5m and up to 3m (see figure 6). The Glider was programmed to go down to 5m, and climb to 3m along a 100m route to the south of the dive point. The results show that there is a slight delay before turning once the required depth has been reached which is as expected, since the Glider cannot anticipate its depth. At one point at the top of the yos, the Glider overshot the 3m depth and made contact with the surface. It then connected to the Dock Server via Iridium and made a GPS fix. Again, the delay between turning and reaching the programmed depth is likely to have caused this behaviour.

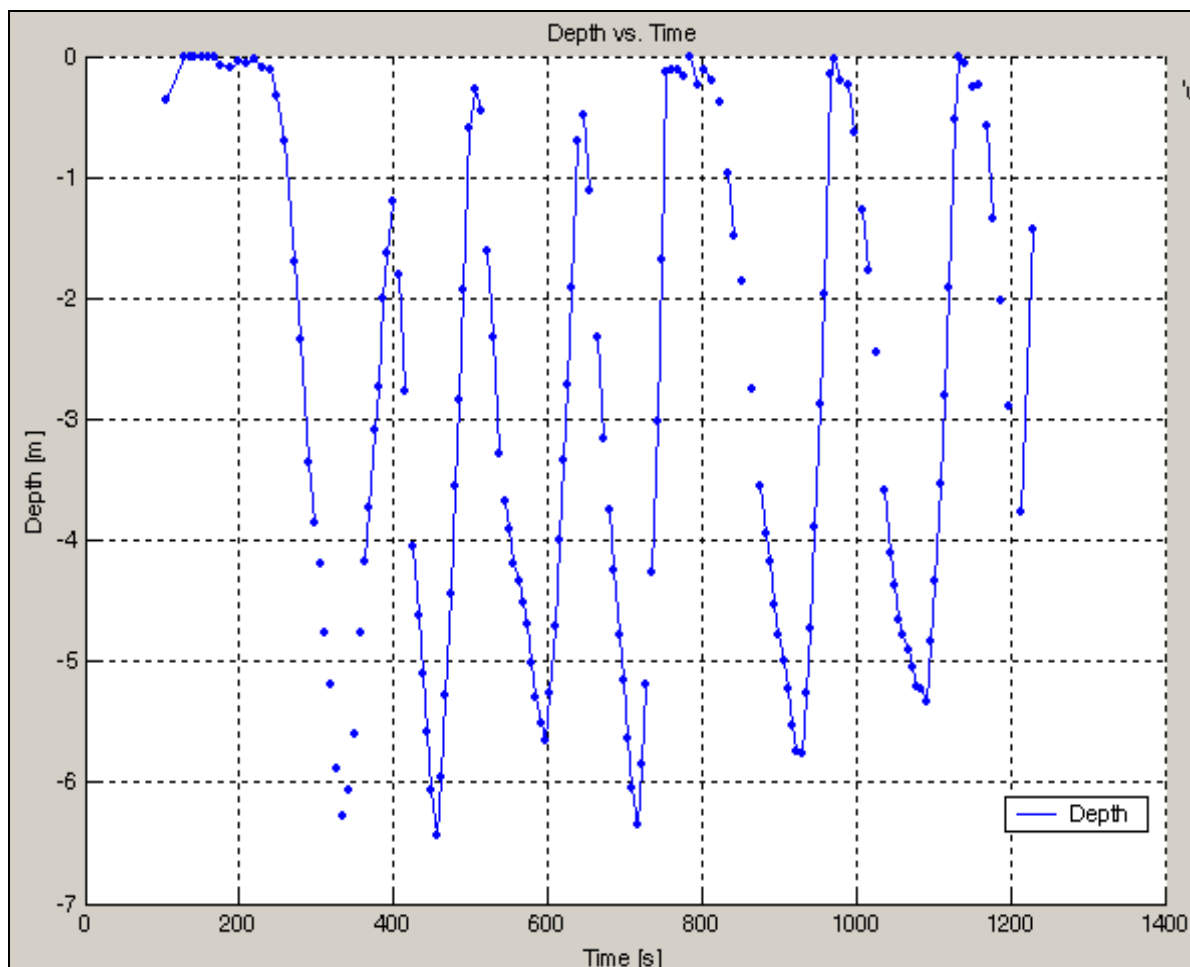


Fig 7. Depth data (*ini2.mi* mission, NO rope/buoy)

The results from the non-pumped SeaBird CTD attached are shown in Figure 7. Water temperatures varied between 11°C and 13°C. The surface waters were cooler than the waters below. Salinity was around 33PSU.

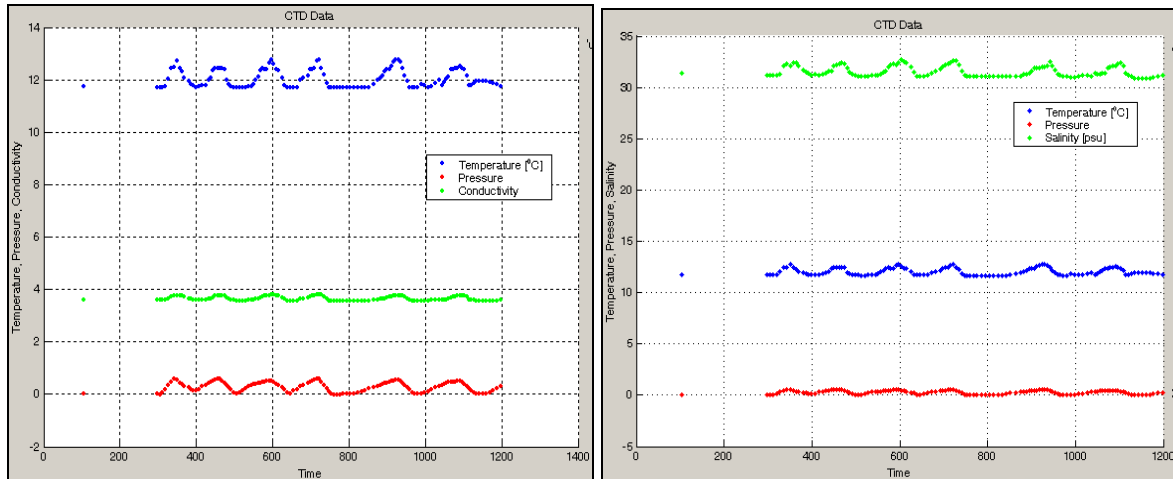


Fig. 8 Data (*ini2.mi* mission, NO rope/buoy) from the attached SeaBird non-pumped CTD (a) Temperature, Conductivity, Pressure, (b) Temperature, Salinity, Pressure

The Glider was programmed to move 100m towards the south from its current position within a 20 minute period. Although near to the end of its mission the Glider did abort due to the time out condition. Figure 8 shows the Glider positions in local mission coordinates, which indicated that it almost reached its 100m objective within the 20 minute period. This may have been caused by the local tidal currents in the area.

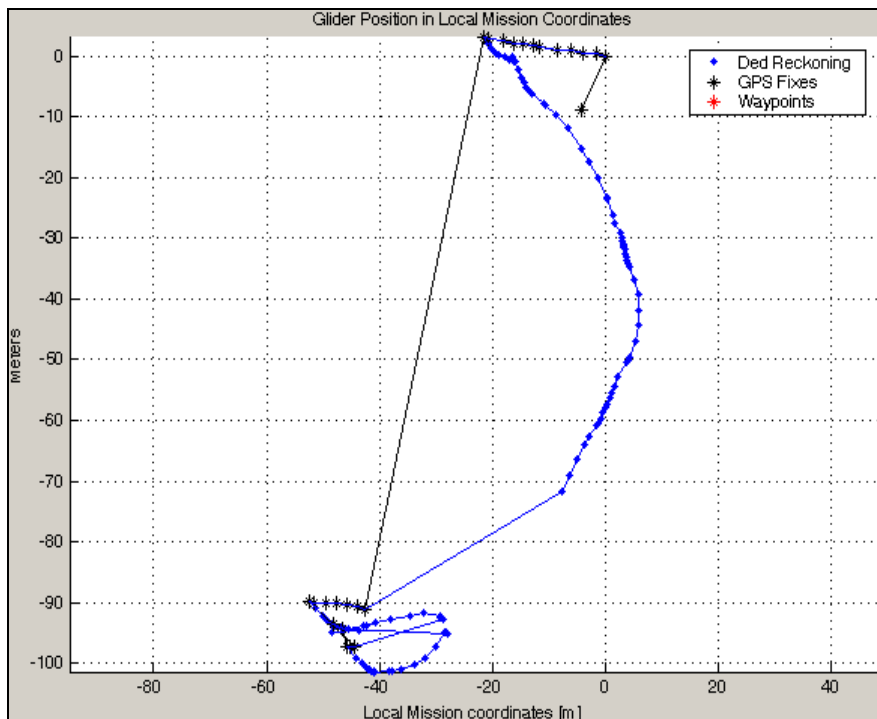


Fig. 9 Glider positions on mission (*ini2.mi*, NO rope/buoy)

Summary

The first Glider trial was successful with a number of tasks completed and tested. A second trial, scheduled for January 2010 and in the same area will run longer missions with deeper dives. This will complete the trials prior to a first Irish Sea mission in spring 2010.

Completed and assessed tasks

- Control of Glider in the water with FreeWave
- Control of Glider with Iridium
- All the test missions run
- Missions tested with and without rope/buoy safety
- Data recorded and checked in the field
- Use of SAMS personnel (experience of local conditions)
- Use of SAMS facility (RV Calanus, bench area provided in lab)

Acknowledgements

The assistance of the master and crew of the RV Calanus contributed greatly to the success and safety of the trial.

Appendix 1

How to setup SSH tunnelling to enable the Glider operator to view the dockserver and Glider control panel when not in Freewave contact.

XP/windows systems

First use an SSH program like Secure Shell (<http://www.ssh.com>)

The machine IP number of the Dock Server is 192.171.134.143. This is the IP number that the Glider via Iridium/RUDICS system connects to via the POL firewall. In order to access this machine it is necessary to go via the POL SSH machine called livgen. You will first need to setup a connection to the POL SSH machine livgen and then form the tunnels to 192.134.134.143. This can be setup within the Secure Shell software before connecting. You will need a POL linux user id and password to connect to livgen.

YOUR laptop >> POL SSH SERVER >> DOCKSERVER

Your PC has to pretend that it is on the POL network. This is achieved by setting up tunnels and using the name localhost in the browser. (Note: If you are on the POLC network a link to <http://192.171.134.143> will bring up the web server on the Dock Server and the java programs will run without editing – Be aware that these java programs stay in cache and may have the wrong IP number encoded – see notes below for editing them when tunnelling). To get at the cache to remove any programs go to the run command on your laptop and type in javaws – viewer.

Connection to POL SSH server

Host name: livgen.erc.ac.uk

User name: (Your POL linux userid)

Port number: 22

Tunnels

The following tunnels are required for FTP access, and web access to the dockserver.

Tunnel #1 Allow access to FTP

Listen port : 21

Destination host : 192.171.134.143

Destination port : 21

Tunnel#2 Allow access to webserver on dockserver

Listen port : 8080

Destination host : 192.171.134.143

Destination port : 80

Tunnel#3 Required for java applications to work e.g. glmvc

Listen port : 6564

Destination host : 192.171.134.143

Destination port : 6564

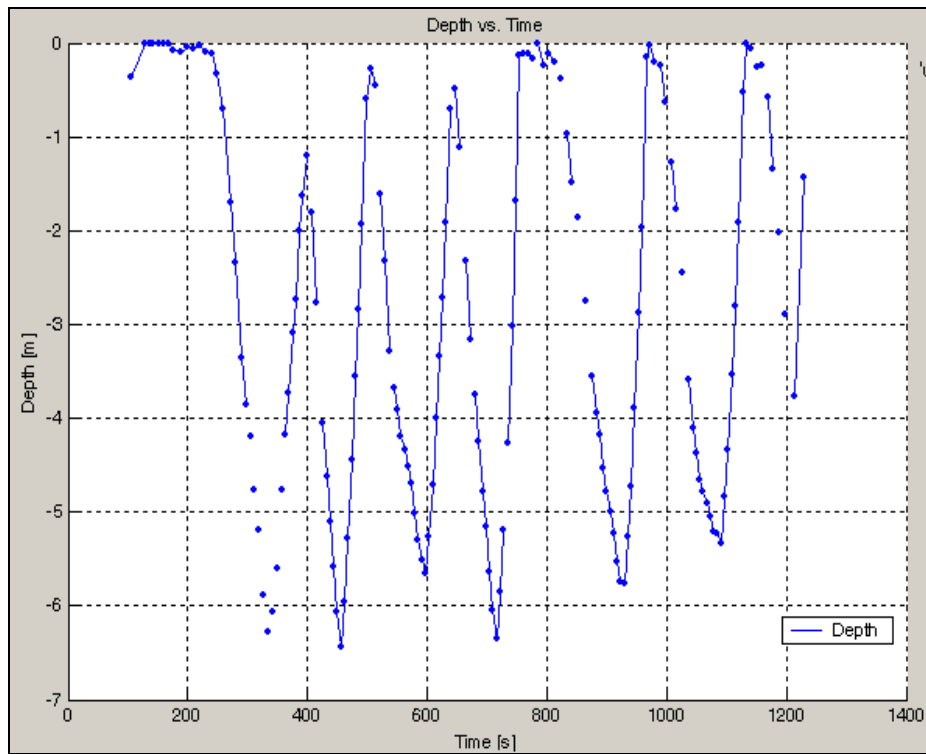
How to access the dockserver

Type in <http://localhost:8080> on your browser once you have setup the tunnelling and connected. Click on the java programs (Glider Terminal, Glmpc). I used a PC copy of WS-FTP instead if the one listed on the Dock Server as it seems to work better. For all the java programs you download you will need to edit them. Inside the code you will to change any references to 192.171.134.143 with localhost:8080, otherwise they will not work.

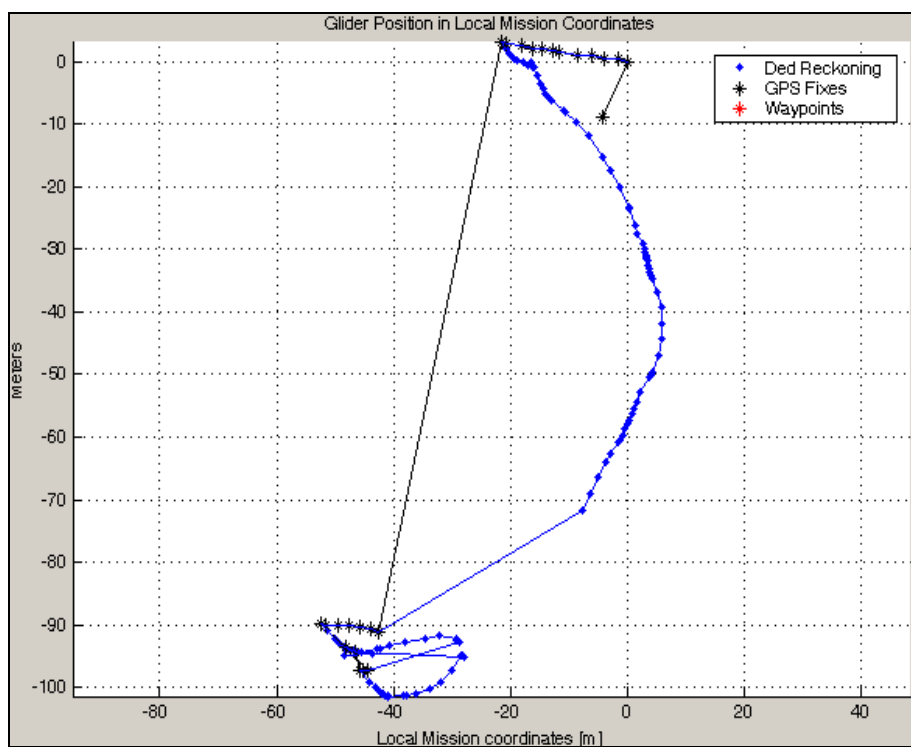
Note that the FTP program uses a different user name and password to the dockserver localuser. These details are listed at the end of Chapter 9 of the Dock Server User Guide (page 121 of revision 3.3 manual)+

Appendix 2 Plots from Glider mission *ini2.mi* (NO rope/buoy)

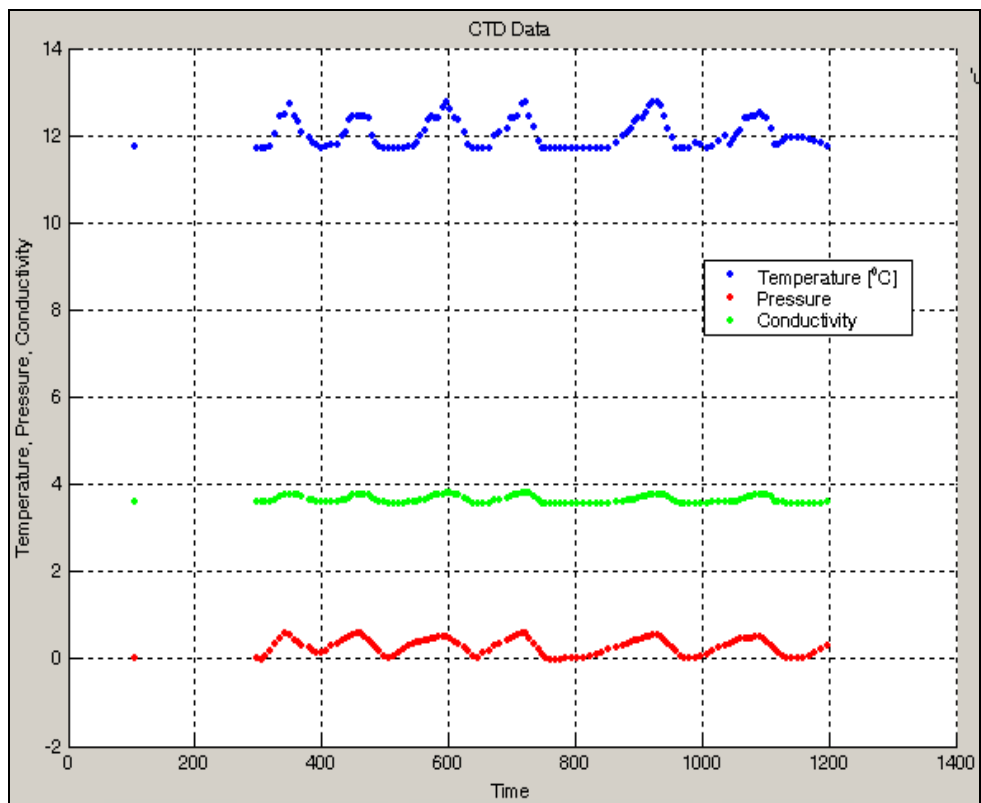
(a) Depth vs Time



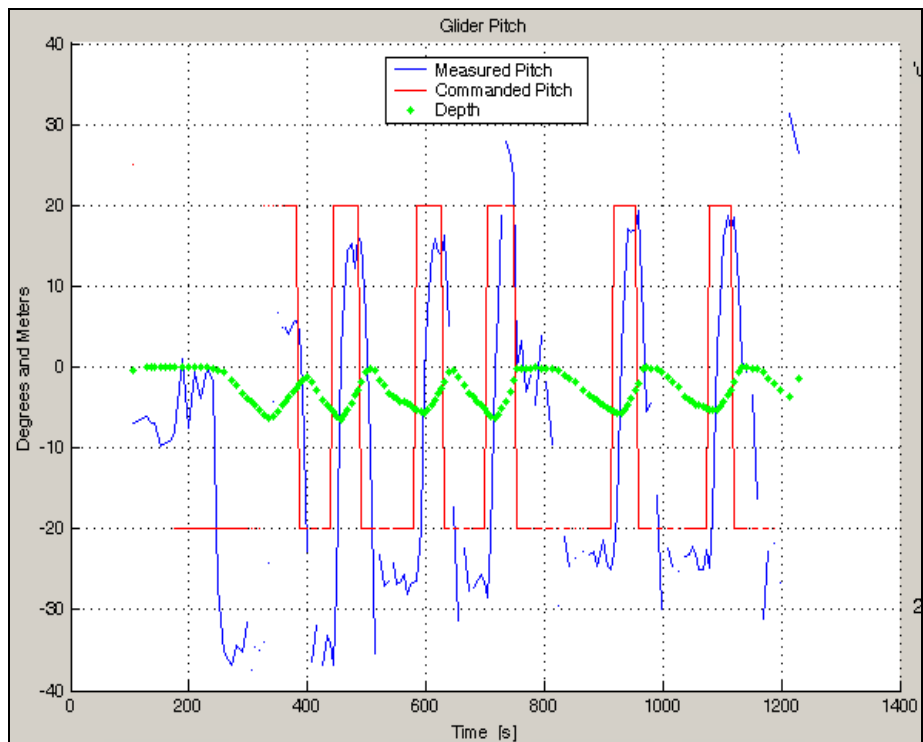
(b) Glider Position in Local Mission Coordinates



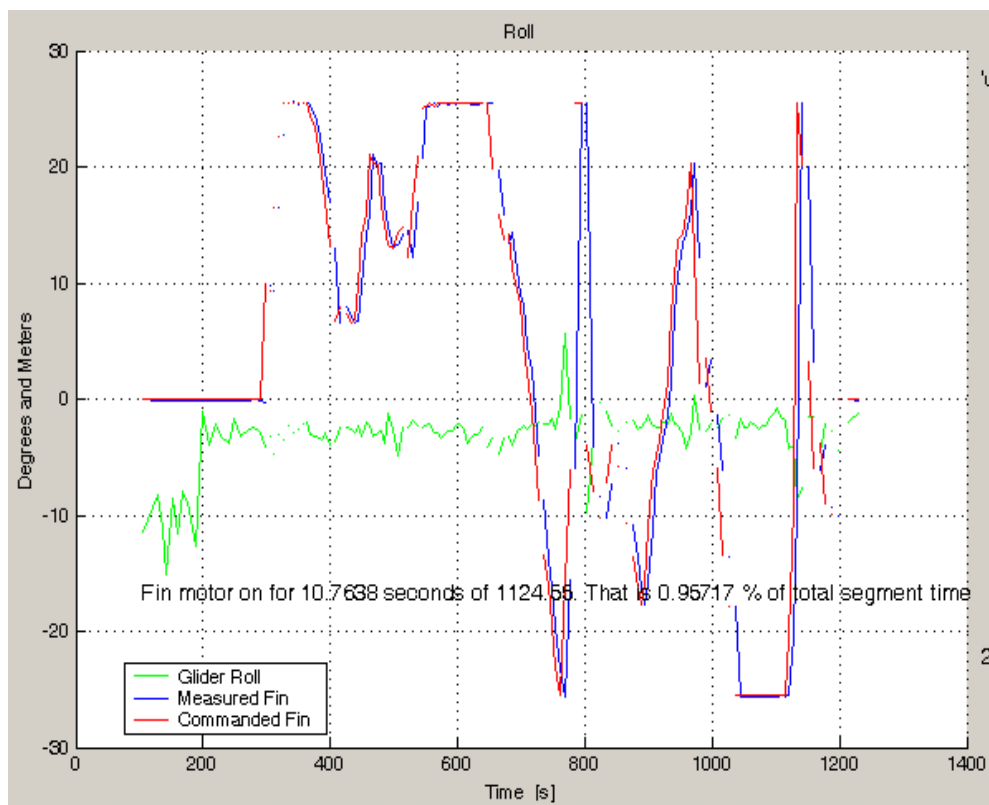
(c) CTD



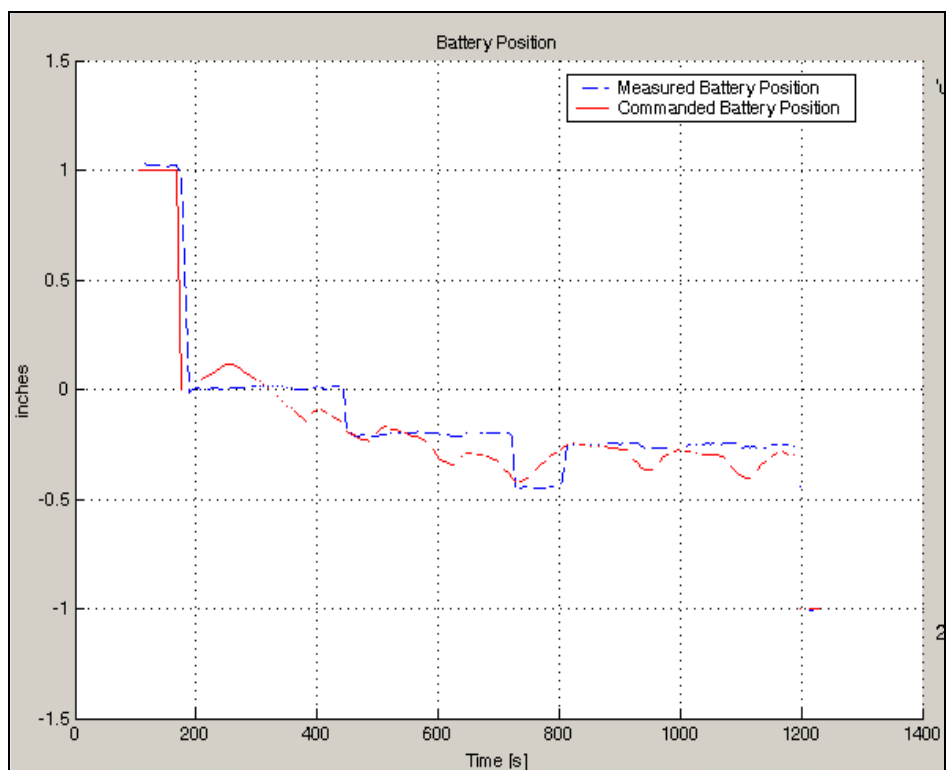
(d) Glider Pitch



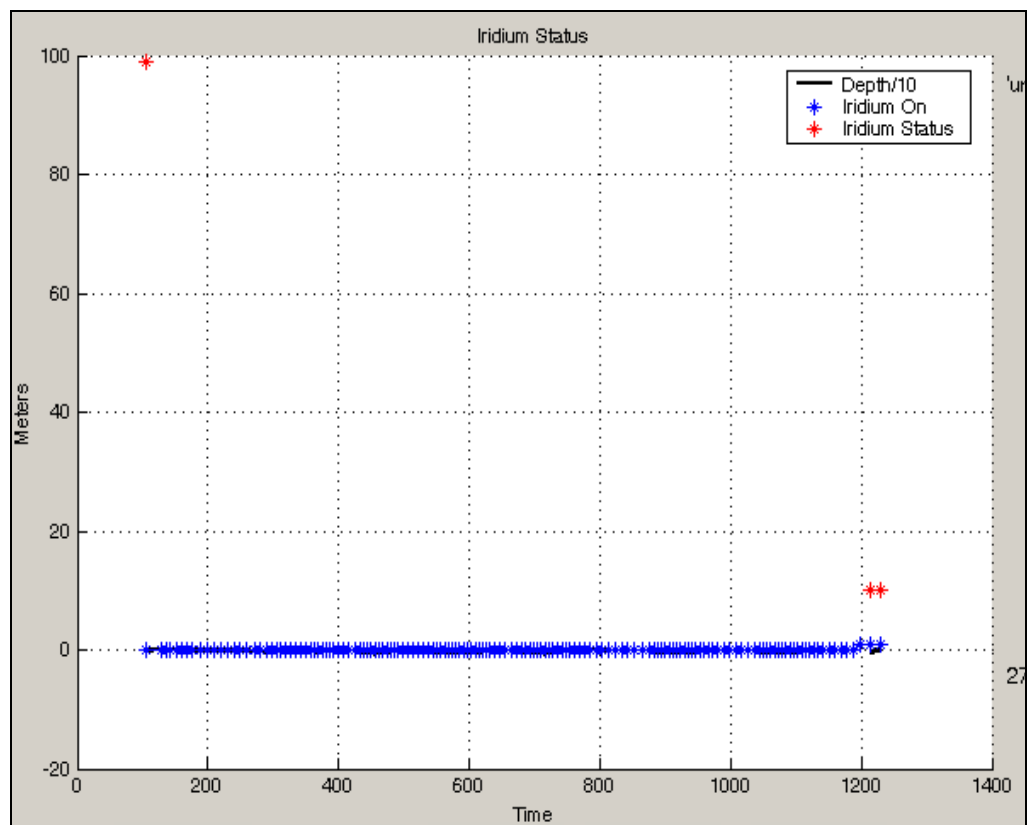
(e) Glider Roll



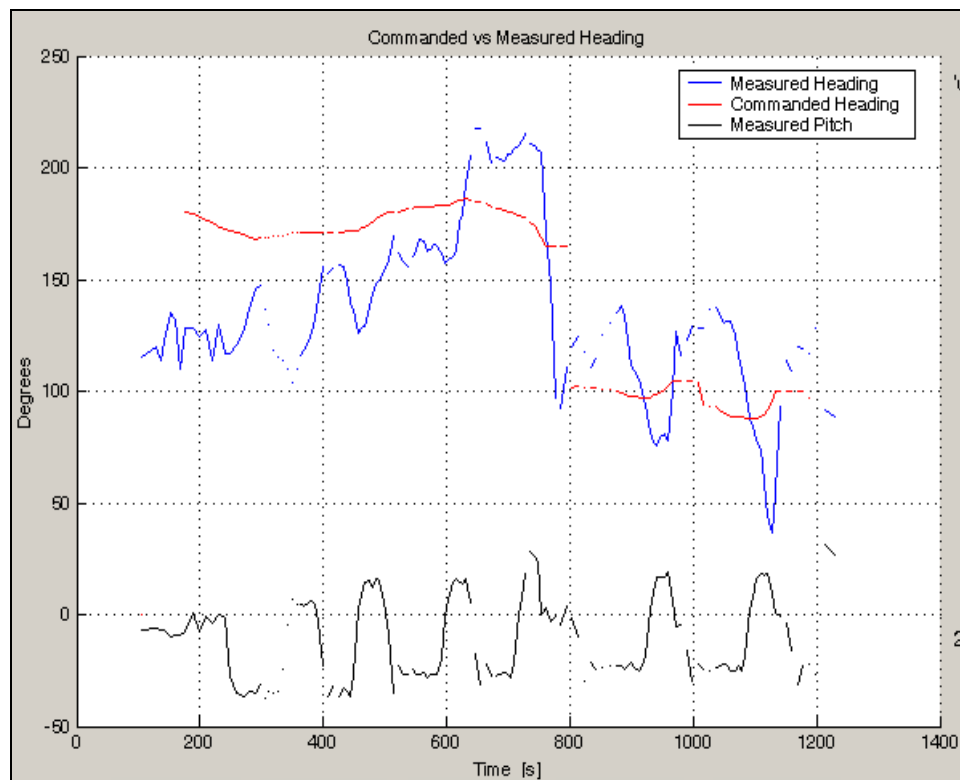
(f) Glider battery position



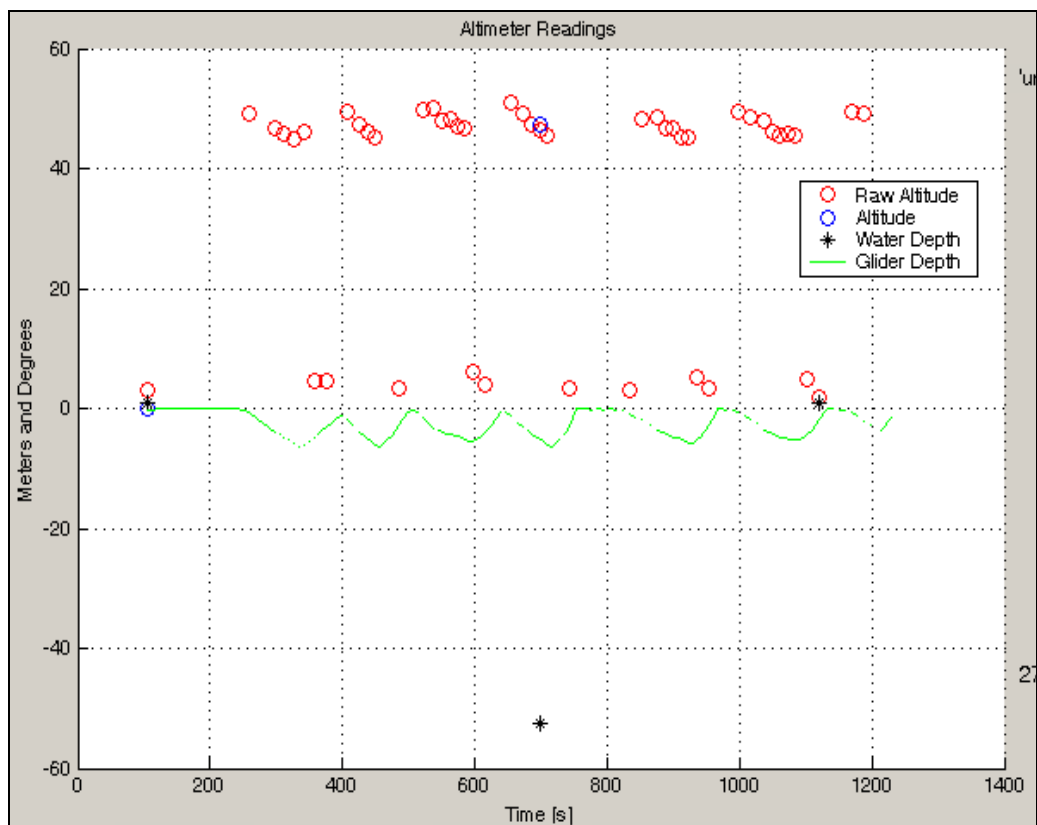
(g) Iridium status



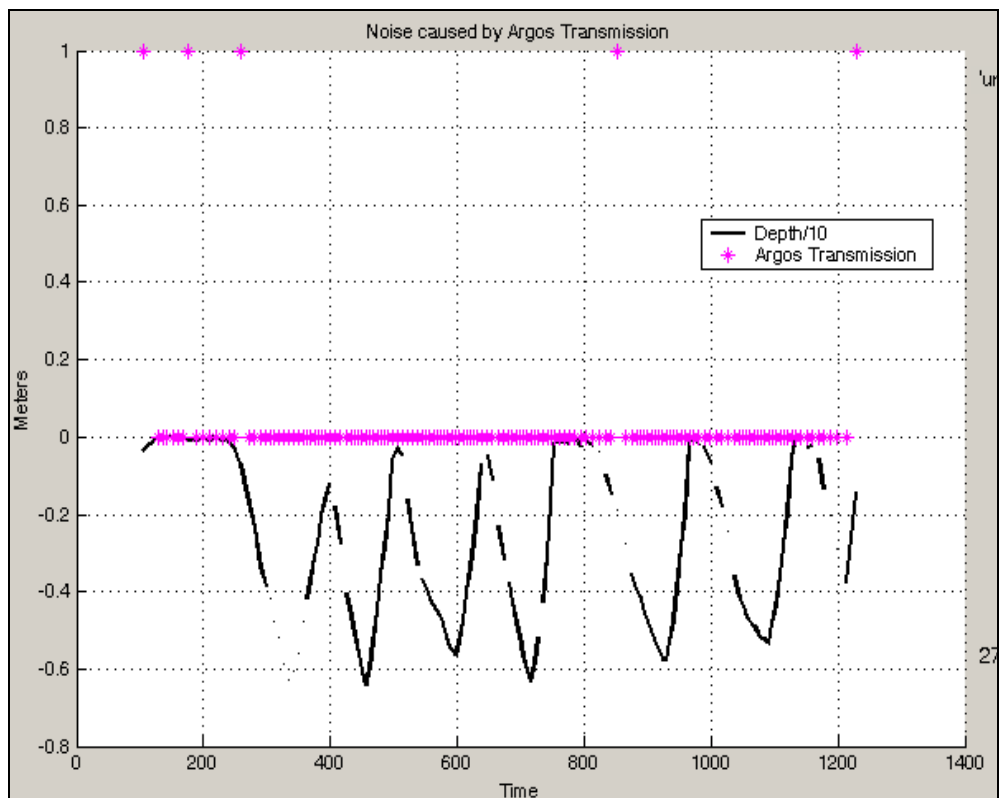
(h) Heading



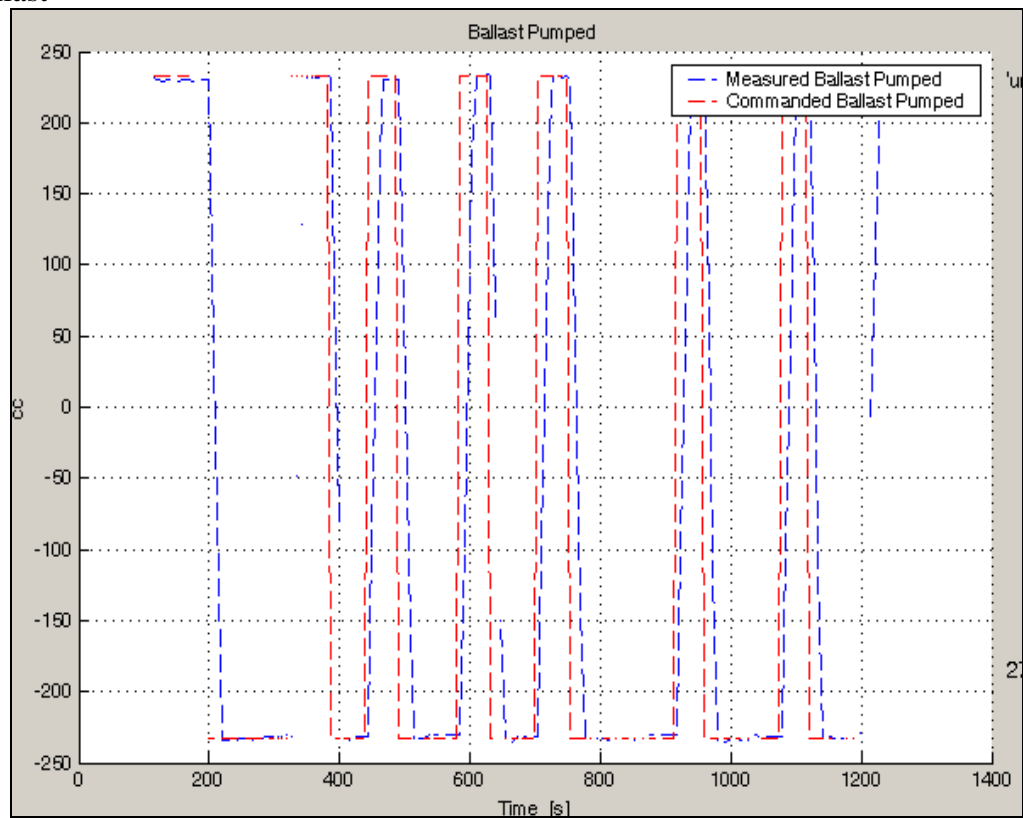
(i) Altimeter



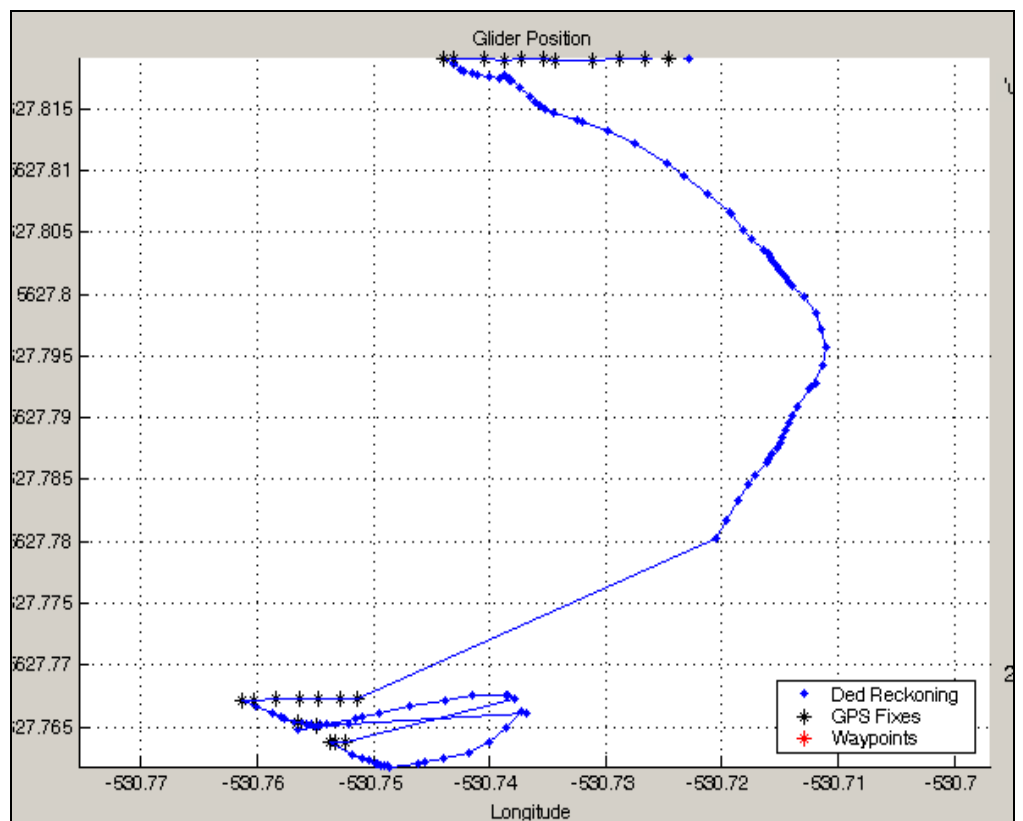
(j) Argos



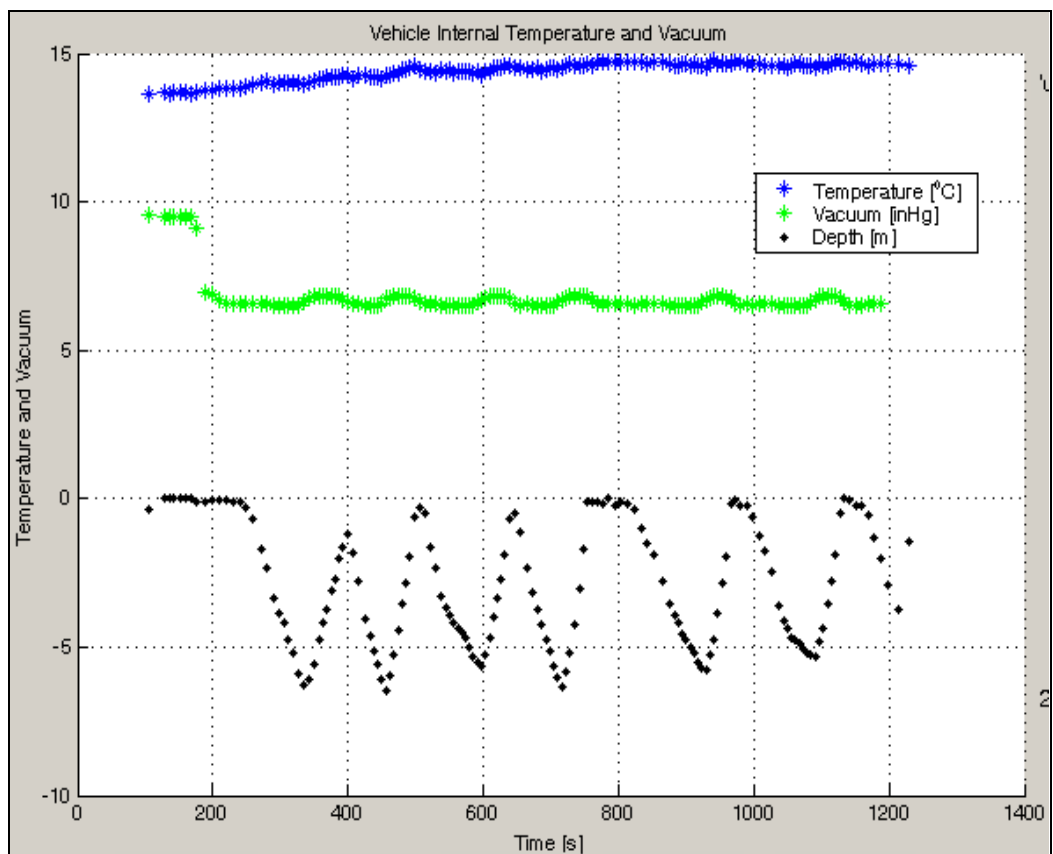
(k) Ballast



(l) Glider position (latitude, longitude)



(m) Internal temperature and vacuum



(n) Battery voltage

